

### IN THE DRAWINGS

Please replace Sheets 1, 2 and 5 of the Drawings with the Replacement Sheets filed herewith.

### REMARKS

#### *Drawings*

In response to the Examiner's requirement that Figures 1, 2, 9 and 10 be labeled "prior art", Applicant submits herewith Replacement Sheets containing these Figures, which have now been so labeled. Applicant introduces no new matter in these Replacement Sheets.

#### *Specification*

The Examiner objected to the original specification as not having the section headings typically found in U.S. practice. In response, Applicant is submitting herewith a substitute specification which comports with 37 CFR § 1.77(b). As a separate sheet, Applicant is submitting an Abstract of the Disclosure, 37 CFR § 1.72(b). No new matter has been introduced by this new Specification and Abstract. Most of the changes therein relate to the insertion of section headings. Applicant has changed the British spelling "localised" to the American spelling "localized" at Paragraph 10, has made "layer" "layers" at Paragraph 27, has corrected "bean" to "beam" in Paragraph 42, and has added a period to the end of Paragraph 55.

#### *Objections to Claims*

The Examiner objected to Claim 1 because "semiconductor material" lacked antecedent basis. Applicant has amended the preamble of Claim 1 to supply the requisite antecedent basis.

The Examiner objected to Claim 3 because of the occurrence of "20" in the second line. This was a PCT application line number, had been introduced herein as a typographical error, and has now been corrected.

The Examiner objected to Claims 7 and 8 because there was no antecedent basis for the adjacency of the recited sub-layer to a cladding layer. This has been corrected by amendment.

The Examiner objected to Claim 13's recitation of a "mode" control layer. This has been amended to a "beam" control layer, an element introduced by Claim 1 from which Claim 13 depends.

**Claim Rejections – 35 USC § 102**

The Examiner rejected Claims 1 – 14, 17 and 18 as anticipated by Hayakawa et al. US Patent No. 4,745,612 ("Hayakawa"). Applicants respectfully traverse this ground for rejection as applied to the claims as now amended.

Referring to Hayakawa's Figure 1, structure analogous to Applicant's first cladding layer is composed by layers 1 – 3 and the left part of 4. The second cladding layer is composed by layers 7 – 9 and the right part of 6. The waveguiding layer is made up of a rightmost part of layer 4, all of layer 5 and the leftmost part of layer 6. (It is noted that layer 5 is far too thin to have any significant waveguiding action.) The first cladding layer includes a beam control layer (2, 3 and the left part of 4) which has a first sub-layer 2 in which the refractive index varies gradually from a first level to a second level, and a second sub-layer (left part of 4) which varies from the second level to a third level. The third level can be chosen to be substantially equal to the first level, at about 0.8 mole fraction, only if one subdivides the layer 4 into a sub-layer component (to the left) and a waveguiding component (to the right). The structure is mirrored by layers 6 – 9.

Importantly, however, the first sublayer in Hayakawa is not contiguous to the second sub-layer, as Claims 1 – 18 now require. Because of the intervention of a constant mole fraction layer 3, Hayakawa provides a "U" shaped profile that has a flat bottom in refractive index. The present invention as now claimed, on the other hand, produces a "V" profile beam control layer that offers

the best improvement in far field beam profile. An advantage of the beam control layer as recited by the claims is its improvement in far field distribution of a laser output, while having little impact on the near field distribution. See Substitute Specification, Paras. 31 and 32 and Figures 5 and 6. Applicant's beam control layer provides a much narrower peak in the far field with substantially greater intensity maximum, as shown in Figure 6.

Claim 5, which is dependent on Claim 1, is additionally patentable for the following reason. In Hayakawa, the refractive index profile of what the Examiner is comparing to Applicant's recited beam control layer has a refractive index profile which goes the wrong way. That is to say, the refractive index profile of the recited beam control layer provides a localized increase in refractive index to form a "mini waveguide", while in Hayakawa the layers 2, 3 and left part of 4 form a localized decrease in refractive index, thereby forming an anti-waveguiding structure. Applicant has amended Claim 5 to render definite the direction in which the refractive index of the sublayer is gradually increasing or decreasing, i.e., relative to the other sublayer contiguous to it.

Alternatively, the Examiner rejects Claims 1 – 14 and 16 – 18 as anticipated by Scifres et al. US Patent No. 4,882,734 ("Scifres"). The Examiner implies that the recited first and second sub-layers can be found in one tooth of a "sawtooth superlattice cladding region", as described for example at Col. 5, line 51 of this reference. This, however, is not the same as the V profile beam control layer because variations in the refractive index of the material of one layer of a superlattice occur over a depth which is substantially less than one wavelength of the light that the device is intended to propagate. It is the average level of the refractive index over a number of superlattice layers that is important. In the present specification, Applicant has pointed out (at Para. 51) that the gradual change in the property of the beam control layer (41, 42, 111, 112, etc.)

preferably occurs through a thickness of at least 50 nm and preferably through 100 nm. A standard definition of “superlattice” is “a structure consisting of alternating layers of two different semiconductor materials, each several nanometers thick.” See answers.com.

As pointed out at Paragraph 52 of the Substitute Specification, a gradual change can be effected in a superlattice or digital alloy with alternating layers of low and high refractive index material “with a localized average thickness ratio that defines the effective refractive index over a dimension of the order of one wavelength of light or less.” But in Scifres, the illustrated V profiles are local variations of a superlattice structure and therefore the local variations are over the order of 60 Angstroms (See Col., 5, line 40) and more generally 20 – 300 Angstroms with a preferred value of 50 Angstroms (Col. 2, lines 26 – 28). This is very substantially smaller than the wavelength of light typically propagating through such lasers, e.g., 800 – 1000 nm.

By contrast, the beam control layers of the present invention require a “gradual change” which “is effectively defined relative to the optical wavelength of light passing through”, see Substitute Specification at Paragraph 52. Claims 1 and 18 require sublayers which have a gradual change in refractive index, as seen by the light propagating through the device. This is supported by Paragraphs 52 and 53 of the Specification and is seen, for example, in Figure 18. To achieve this with a superlattice structure requires a gradual change of refractive index levels or mark-space ratio of high to low levels over tens of superlattice layers. This is exactly as envisaged in Figure 18 of the present application, as discussed at Paras. 52 – 55. Applicant has amended Claim 16 to recite “sub-sub-layers” which together compose a sub-layer. While “sub-sub-layer” is not mentioned per se in the Specification as originally filed, Applicant feels that this term is more definite than simply repeating “sub-layer”, and Applicant employs the term here to point to subordinate layers of sub-wavelength thickness which together form an

effectively waveguiding “sublayer”. The “sub-sublayers” 181 – 185 can be seen composing more macroscopic “sublayers” in Figure 18.

The only place in which Scifres suggests gradual changes in the average refractive index over a number of layers of the superlattice are Figures 7 – 10, which show gradual changes over four or five cycles of the superlattice (50 Angstroms x 4 = 200 Angstroms or 20 nm). But the structure offered in Scifres, Figures 7 – 10, does not disclose or suggest the V profile beam control layer including a first sub-layer in which the refractive index varies gradually from a first level to a second level, and a second sub-layer in which the refractive index varies gradually from the second level to a third level, wherein the first and second sub-layers are contiguous, and wherein the third level is substantially equal to the first level, all as now required by Claims 1 and 18. In Scifres Figs. 7 – 10, the gradual changes in average refractive index occur in one direction only on either side of the quantum well regions 82, 90, 102, 110 and thus neither anticipate nor render obvious the beam control layers specified in independent Claims 1 and 18 as amended.

### **Claim Rejections – 35 USC § 103**

The Examiner combines either Scifres or Hayakawa with Applicant's alleged admission that ridge lasers are prior art, in order to reject Claim 15. Claim 15 is dependent on Claim 1, which in turn is allowable for the reasons given above. Given the fact that Claim 1 is patentably distinct from all known prior art, the statements in Applicant's Background of the Invention do not render obvious the invention as claimed by Claim 15.

To accompany Applicant's amendments to Claim 1, Applicant has made consequential amendments to Claims 7 – 10, which all now recite variations in the refractive index. Claim 3 now recites composition as an additional variant property.

**Conclusion**

All objections and rejections of the Examiner having been met, Applicant now respectfully requests the Examiner to issue an early Notice of Allowance. If there are further issues the Examiner is invited to telephone the undersigned.

This Reply to Examiner's Action is being submitted with a fee for two months' extension of time, as charged to Deposit Account No. 503982 of Momkus McCluskey, LLC at the time this Reply is electronically submitted. The Commissioner is hereby authorized to charge any deficiency relating to this submission to Deposit Account No. 503982 of Momkus McCluskey, LLC.

Respectfully submitted,

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